Methane Digester: Odor Reduction Breakthrough

Prototype earthen, covered lagoon system destroys offending compounds.

By Joe Vansickle
Senior Associate Editor

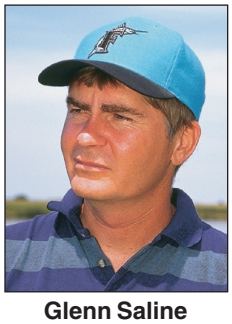
A unique, low-cost methane digester may just be the "silver bullet" for odor control that some lagoon owners have been seeking.

For Glenn Saline of Apex Pork it signals the end of a long road of soul-searching and neighbors' complaints that the single-cell lagoon at his 8,600-head finishing site gave off offensive odors.

The Rio, IL, pork producer observes, "We had some significant startup odor coming off our lagoon (that was) constructed in 1995. Most of those odors started in spring 1996.

"I think we've dramatically reduced those odors and we're expecting that to continue to improve because we've reduced loading into our storage lagoon with the construction of our digester."

Of the three production sites at Apex Pork, only the finishing site has had any major lagoon odor problems.



Glenn Saline

Detours Along The Way

There's no doubt the lagoon was under-sized when it was built, remarks consulting agricultural engineer Terry Feldmann, Feldmann & Associates, East Peoria, IL. "It has a large, 6-acre surface area but it is only 13-ft. deep. It wasn't pre-charged with enough fresh water. The result of all this was that it emitted pretty excessive odors," adds Feldmann, who assisted with construction of the methane digester and periodically returns to gauge its progress.

Saline and Feldmann tried several options over the years. First was a microbial additive product which Feldmann says did reduce lagoon odors but not to an acceptable level.

Then the pair looked seriously at a solids separation settling basin that would reduce the loadings into the lagoon. But that called for a significant amount of cropland for manure application. Acreage is limited at the finishing site, explains Feldmann.

Instead, Saline settled on a more aggressive plan – an anaerobic methane digester designed just for odor control. Feldmann believes it is the only operating pig manure digester in Illinois and one of a few in the Midwest. And uniquely because it is earthen, mixed, covered and heated, it provides year-around digestion of manure solids and a constant reduction of odor-causing compounds.

"We have such low concentrations that there is virtually no odor coming off the lagoon," attests Feldmann, standing downwind on the lagoon's neatly trimmed berm.

Digester Design

To build the methane digester, Saline and Feldmann turned to the Environmental Pollution Agency's (EPA) AgSTAR program to provide technical aid and support for the design. AgSTAR is a voluntary, federal EPA program aimed at promoting recovery and use of methane from animal manure. (For more information, call (800) 95AgSTAR.) Actual digester design for Apex Pork was developed by Mark Moser, Resource Conservation Management, Berkeley, CA.

Installation began in the fall of 1997, and was completed in the spring of 1998, recalls Feldmann.

But the project was dealt a serious blow when a windstorm struck the site, blowing down a nearby barn, ripping the digester cover and compromising its gas-collection capabilities.

The easiest solution seemed to be to add another cover over the original. The 40-ml.-thick, floating cover from Environmental Fabrics, Gaston, SC, was installed in late December 1998. To prevent the wind from lifting it at the perimeter, the edges of the cover for the 120 x 160 ft., 17-ft.-deep digester are buried in a 2-ft. trench, explains Feldmann. The digester began full operation this past winter.

Digester startup has been a big part of its success, say both Saline and Feldmann. There were two keys. First, "good" bacteria was pumped over from the lagoon at the sow farm which has been working well. Second, using propane to start heating the digester, the temperature was raised just 2º/day so that other factors like pH and carbon dioxide in the slurry could be properly monitored and maintained, says Saline. At the start, digester temperature was in the 50-60º F range. The goal is to maintain digester temperature at 95-105º F.

Processing The Manure

Apex Pork is a three-site, 2,500-sow, farrow-to-finish operation. On the methane digester site are nine, grow-finish (50-250 lb.) buildings, featuring 2-ft., pull-plug manure pits with pit recharge.

Normally, one building per day is drained by pulling the plug on the shallow manure pits. The manure drains to the end of the buildings, is piped through a central line and into the digester. The digester is sized to hold roughly 20 days' worth of manure. Once full, it maintains a static volume with 2 ft. of freeboard. Digested manure trickles over

At left, Terry Feldmann takes a slurry sample from the main lagoon to develop a nutrient profile and monitor levels of odorous compounds. Excess methane is flared off into the atmosphere.

into the corner of the digester. When the level of slurry reaches the "T" of a 10-in.-diameter PVC pipe, the effluent trickles through the pipe underwater into the main storage lagoon, explains Feldmann. The hope is that by releasing the effluent underwater, freezing is prevented and odors are minimized. The lagoon is located adjacent to the digester and they share the same berm.

Aiding the digester "processing" of the manure is a mechanical mixer. An 8-hp., submersible, propeller mixer, located near the bottom of the digester, is on a timer that once a day mixes and suspends manure solids. The digester breaks down these "volatile solids" and converts them into methane, carbon dioxide and water through bacterial digestion. Moser estimates that only 20-40% of solids remain.

In the process, the methane gas bubbles toward the top and the biogas is collected into PVC pipes with holes in it just under the cover of the digester. The biogas produced is about 60-65% methane and 30-35% carbon dioxide. The biogas is sucked through pipes using a vacuum pump into a small building. There the gas is burned in a boiler (like a hot water heater), heating water that is pumped back into the digester through a network of over 650 ft. of specially designed, 3-in. black steel heat pipes designed to maintain the temperature of the slurry.

Separately, excess methane gas is pumped out and flared off into the atmosphere, explains producer Saline. "In the summer, it doesn't take a whole lot of biogas to keep the digester warm, so you end up flaring off a lot of it," points out Feldmann. In winter, most (80-100%) of the gas is used to heat the digester.

The black digester cover also absorbs heat from the sun and keeps heat in with 2 in. of foam insulation that is sandwiched in between the original and the new digester cover.

"One of the neat advantages of a heated and mixed digester like this is we are able to maintain these high temperatures year-around," says Feldmann. "So we don't have much problem with those sensitive methanogens (methane-producing bacteria) that like it warm and keep lagoon odors at a constant low level."

Those low odors are also a big plus for land application of effluent, he comments. "We've converted a lot of the organic nitrogen into the ammonium form so it is more readily available to the crops."

Cost Control

Saline wanted to keep digester costs down but he also wanted to ensure its success. Instead of building a typical, total concrete methane digester, he opted for an earthen lagoon with a 22- x 56-ft. concrete bottom to maintain structural integrity of the cavity during mixing.

A typical methane digester is coupled with an electrical generator for producing electricity from methane. Eliminating the generator saved about $100,000.

That leaves the "boiler room" and the digester itself. "I wouldn't say it is a cheap system but it is pretty much self-sufficient," remarks Saline. About all he does to maintain it is to daily check the temperature level of the water returning to the digester and make sure all the pumps are operating smoothly.

For his part, Feldmann used to routinely test the finishing site for odor levels. He recalls using a scentometer, recording smells up to a half mile away. Now he doesn't even use the device because the odor levels are so low.

Saline places the total digester cost at $150,000. Plus, there is a small electricity cost to run the pumps. The boiler itself is heated by the methane gas.

That's a big investment these days to most producers. But Saline smiles and shrugs and remarks it's still a small price to pay for piece of mind and the right to coexist in this west central Illinois community where his dad and uncle have raised hogs in confinement for the past 30 years.

"We think our approach is very aggressive and proactive," stresses Saline. "We feel like we have tried hard and we feel good about what we have done here," he comments.

And Feldmann adds a methane digester is a viable option of odor control for a large-scale operation (4,000- to 6,000-head finishing and up). Sure, the initial cost of the system is on the high side, but that can be balanced off by the less acres needed to apply the low-odor lagoon effluent and a smaller storage basin rather than a large treatment lagoon. ♢